

## OPERATING HEAD FOR AUTOMATIC MACHINE TOOLS, WITH PROJECTING INTERCHANGEABLE CHUCK UNIT

This invention relates to an operating head for automatic machine tools  
5 with a projecting interchangeable chuck unit.

In particular, the head in accordance with the invention comprises a  
support that rotates around a first axis, which said support incorporates a  
power transmission system, and a kinematic mechanism for angular  
positioning of the chuck unit around a second axis, usually orthogonal to  
10 the axis of rotation of the support.

A plate integral with the chuck assembly is fitted with couplings designed  
for the connection of the said support.

The chuck assembly incorporates a power unit or motorised chuck  
suitable to perform high-speed finishing tasks.

15 This characteristic allows the operator to change over from roughing to  
finishing tasks without replacing the entire head (as is necessary with  
known equipment in which the chuck assembly is mounted on a fork  
support), merely by replacing the chuck unit, a much quicker and cheaper  
operation.

20 The automatic machine tools used to perform chip-forming tasks such as  
milling, contouring, etc., comprise a support that moves along three  
orthogonal axes on which an operating head with two degrees of freedom  
is mounted; the said operating head carries a tool unit consisting, for  
example, of a chuck or motorised chuck, on which the tool required for  
25 each task is mounted.

The structure and characteristics of these operating heads vary considerably, depending on whether the job in hand is a high-power task, performed with a roughing tool which rotates at a relatively low speed (max. 3000-5000 rpm) and removes large amounts of material, consequently discharging considerable reactive forces onto the structure, or a finishing/milling task, performed with a tool which rotates at high speed (up to 15,000-30,000 rpm).

The stresses to which the tool is subjected during these various types of work, which are discharged onto the structure and the upstream devices, require the use of chucks with different characteristics and dimensions, which means that different operating heads have to be manufactured.

In accordance with the present state of the art, when the operator wishes to change over from a high-power task to a finishing task, the entire operating head must be replaced, involving very high costs.

These factors lead to an increase in overall costs, due not only to the longer production times but also to the need to have two or more operating heads complete with the corresponding kinematic mechanisms, if not two or more separate machines used for roughing, finishing or other complementary tasks.

This problem is solved by the present invention, which relates to an operating head for automatic machine tools that includes an interchangeable chuck unit fitted to project from a support, which said unit can be replaced quickly and easily with a chuck of different characteristics.

For example, as the power transmission system and angular positioning

devices of the chuck are built into the support to which the chuck unit is fitted, the operator can switch from a power chuck to a medium- or high-speed motorised finishing chuck very quickly, with no need to replace the entire head.

5 This invention will now be described in detail, by way of example but not of limitation, by reference to the annexed figures in which:

- figure 1 shows a cross-section of the operating head in accordance with the invention
- 10 • figure two is a side view in partial cross-section of the operating head illustrated in figure 1, showing the arrangement of the couplings which lock the various chuck assemblies and the corresponding hydraulic and electrical power supplies which drive the automatic operating devices
- 15 • figure 3 schematically illustrates the interchangeable chuck unit, on which a motorised chuck is fitted
- figure 4 shows the plate fitted to the chuck unit for connection to the corresponding support.

In figure 1, no. 1 indicates an operating head in accordance with the invention, fitted to a sleeve 2 in such a way that it can rotate around a first  
20 axis identified as "C".

The head comprises a support 3, fitted to the sleeve via bearings 4, a chuck unit 5 being mounted on the said sleeve. Interchangeable chuck unit 5 may be a chuck, as illustrated in figure 1, or a motorised chuck, as illustrated in figure 3.

25 A shaft 6, connected to motor systems not illustrated in the figure,

transmits motion via a bevel gear pair 7 to a second, inclined shaft 8, which, via another bevel gear pair 9, rotates a shaft 10.

A coupling of known type is fitted at the end of shaft 10 to transmit motion to shaft 11 of another bevel gear pair 12, fitted to the chuck unit and  
5 connected to power chuck 5.

The invention is not limited to the configuration illustrated, but also covers all equivalent solutions.

For example, in the case of power transmission systems, the invention will not be limited to the solution with an inclined shaft, but also extends to  
10 heads with other types of transmission, such as those with parallel and/or orthogonal shafts and the like.

The chuck unit is shaped in such a way as to form a coupling for connection to a body or support 16 with a set of pins or shanks 14, which are gripped by gripper elements 15 of known type fitted to support 16, to  
15 lock chuck 5.

Support 16 is fitted with toothing 17 which is engaged by corresponding toothing 17' present on the body of the chuck, and acts as a location plate for the correct positioning of the chuck.

Alternatively, in order to position the chuck unit precisely in relation to  
20 support 16, different devices can be fitted instead of the reference toothing, such as pins inserted into corresponding seatings in the adjacent piece or other systems.

A set of rapid couplings of known type 25 and 26 is fitted to the plate which constitutes the interface between the chuck unit and its support; the  
25 said couplings 25 and 26 are designed to connect the unit to electrical

power supply devices and fluid supply devices, such as lubricants or coolants, respectively (fig. 2).

A motor 18, schematically illustrated in figure 2, causes corresponding tothing 20 on support 16 to rotate via a cogwheel drive 19 with take-up  
5 system of known type.

Motor 18, controlled by a transducer, controls the angular positioning of the chuck unit around an axis identified as "A".

As will clearly appear from the description and the annexed drawings, chuck unit 5 can easily be removed, as it is only connected to the  
10 transmission devices via a coupling which requires the two parts to be brought into contact with one another and clamped with a simple, straight approach movement; it can therefore be detached with no need to remove any part of the head, merely by activating grippers 15 to release shanks or pins 14 and disconnect the electric and hydraulic couplings.

15 Chuck 5 can therefore be quickly and easily replaced with a different chuck unit which has the same coupling, such as a motorised chuck designed to perform high-speed finishing or milling tasks.

Subsequently, during operation, motor 18 will cause support 16 to rotate in order to position the chuck around axis "A", whereupon, in the case of  
20 machining performed with three machine axes (3+2 mode), support 16 will lock in the position reached.

For this purpose, a ring-shaped chamber shown as no. 30 in figure 1, with walls made of a deformable material, is fitted around support 16.

Chamber 30 is connected to means designed to convey pressurised fluid  
25 into the chamber so as to deform the walls, dilating them outwards in

order to lock support 16 by friction.

Machining can be commenced by rotating the chuck tool via the transmission system constituted by shafts 6, 8, 10 and 11.

In the case of machining with 5 simultaneous axes, motor 18 will  
5 continuously vary the angle of the chuck unit under numerical control.

Chip-exhausting devices are also fitted, comprising a ring-shaped chamber 21 which surrounds the base of the head and contains one or more slits fitted with a rapid coupling 22 of known type for connection of an arm 23; another arm 24, which terminates close to the tool, is  
10 connected to the end of the said arm 23.

During machining, chips and/or dust are exhausted through ducts 24, 23 and 21 by devices of known type; if the chuck needs to be replaced, it is sufficient to disconnect ducts 23 and 24, which are removed together with the chuck and replaced by new ducts associated with the chuck to be  
15 fitted to the head, the said new ducts being connected via rapid coupling 22.

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